United States Patent [19]

Corbett

[11] **4,118,969**

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[54] **DOUBLE ACTION FASTENER INSTALLATION TOOL FOR BLIND RIVETS AND THE LIKE**

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[73] Assignee: **Huck Manufacturing Company,** Detroit, Mich.

[21] Appl. No.: **819,495**

[22] Filed: **Jul. 27, 1977**

[51] **Int. Cl.**[2] **B21J 15/34**

[52] **U.S. Cl.** **72/391;** 72/453.17

[58] **Field of Search** 72/391, 114, 453.17, 72/453.02; 29/243.52; 91/412

[56] **References Cited**

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Assistant Examiner—Gene P. Crosby
Attorney, Agent, or Firm—Harness, Dickey & Pierce

[57] **ABSTRACT**

An improved fluid actuated double action pullgun for installing blind rivets, particularly of the lock spindle type, which includes an improved shift valve mechanism. The shift valve employes a ballseat relief valve associated with pressure responsive plunger mechanism and spring responsive ball guide mechanism which respond to pressure differentials to directly monitor pressure in the trapped oil circuit and restrain "shift piston" motion prior to shift. Premature "shift piston" travel, which is a malfunction, is eliminated.

2 Claims, 13 Drawing Figures

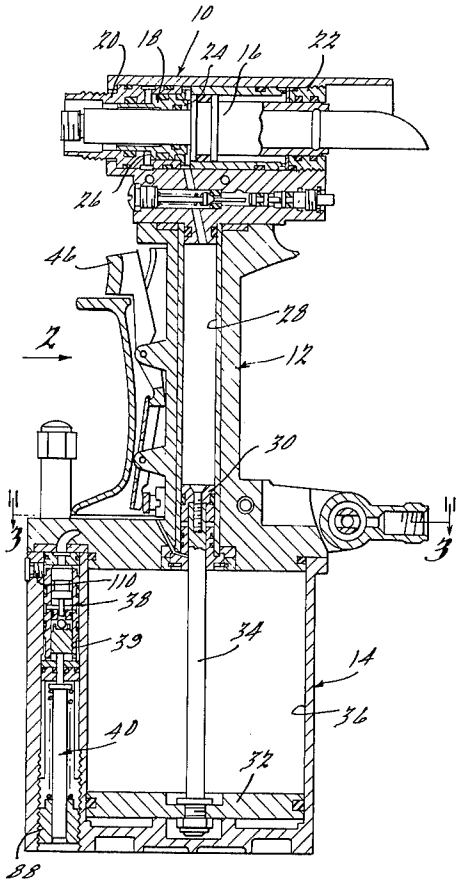
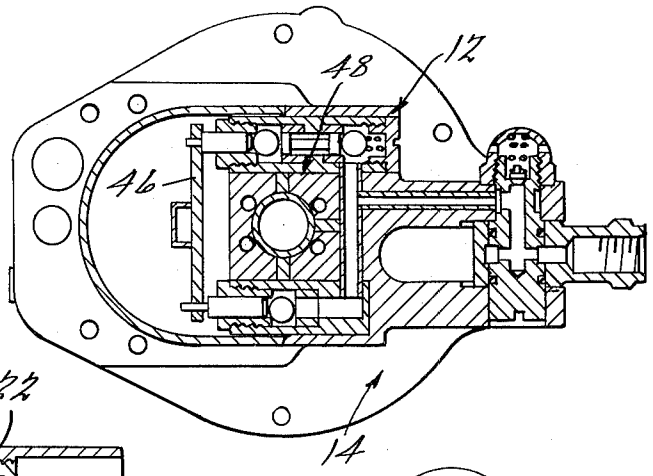


Fig. 3.



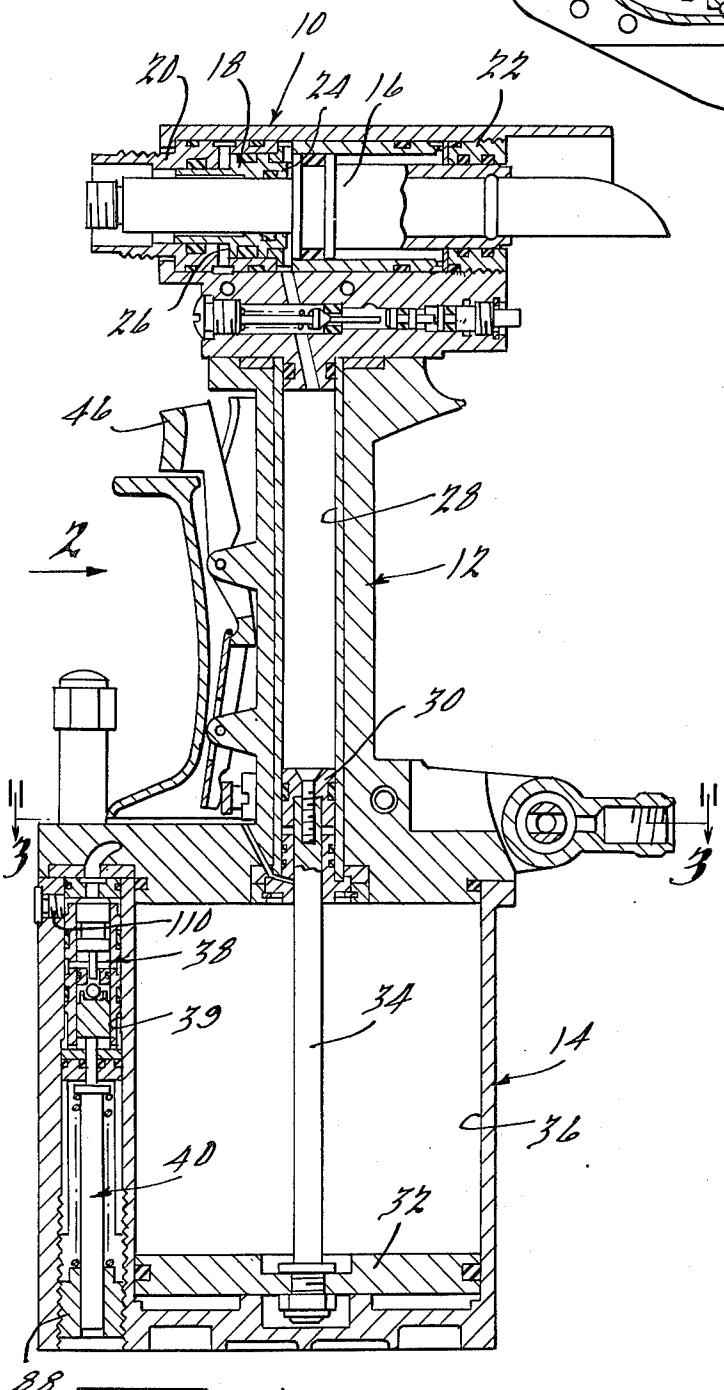


Fig. 1.

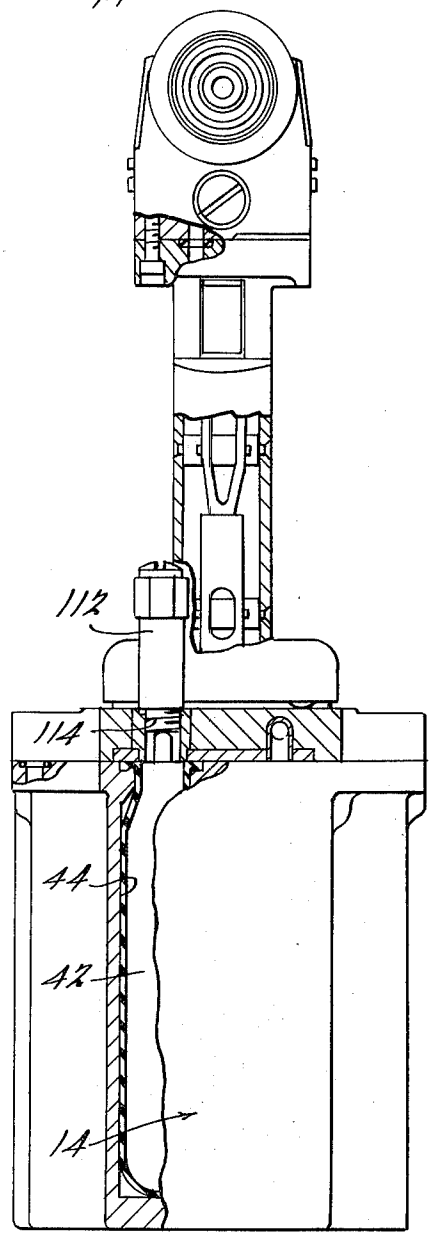


Fig. 2.

Fig. 4.

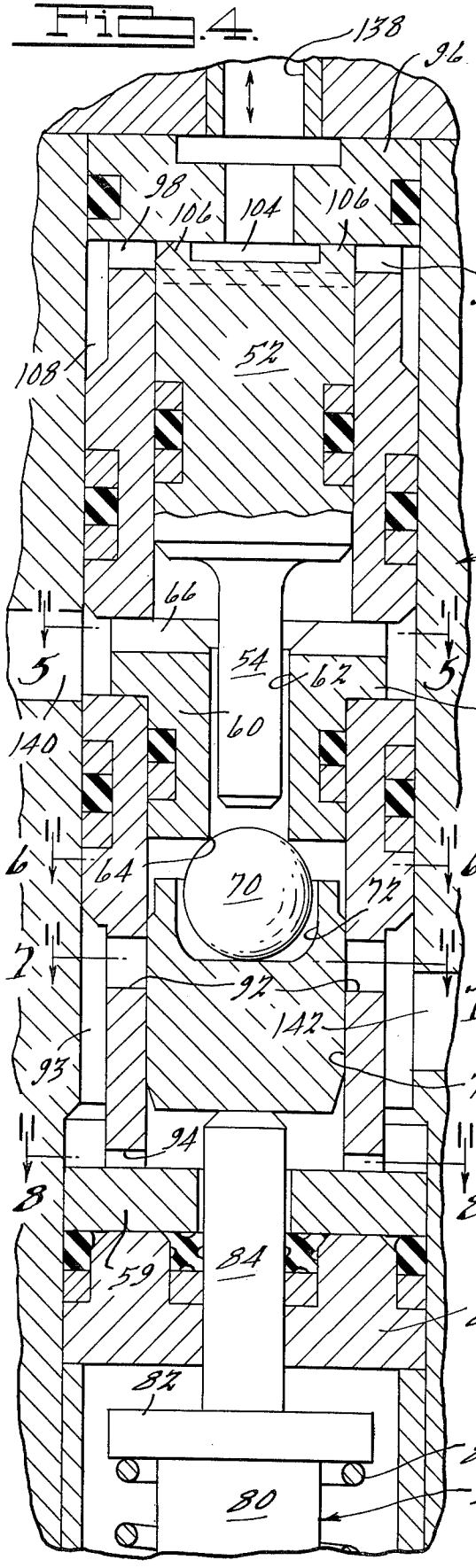


Fig. 5.

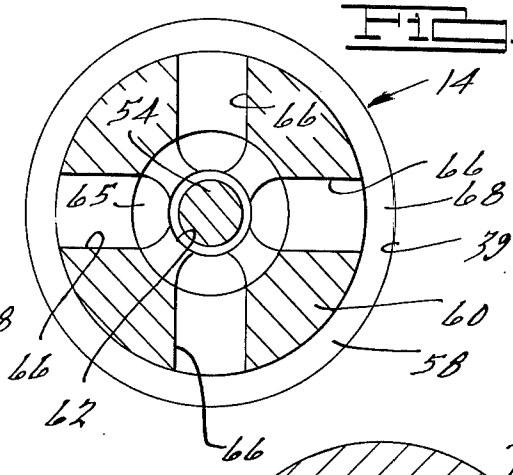


Fig. 6.

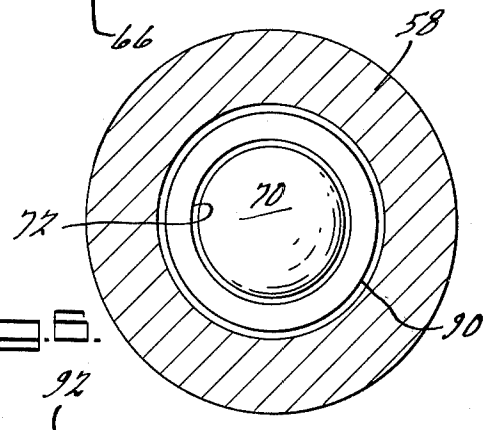


Fig. 7.

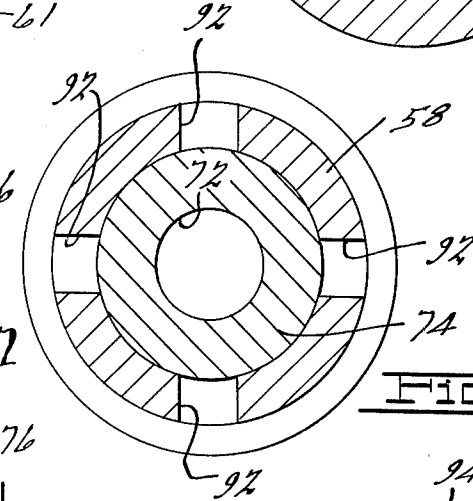
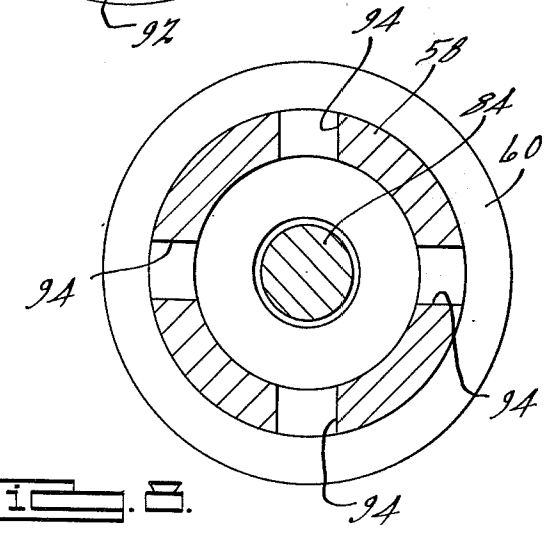


Fig. 8.



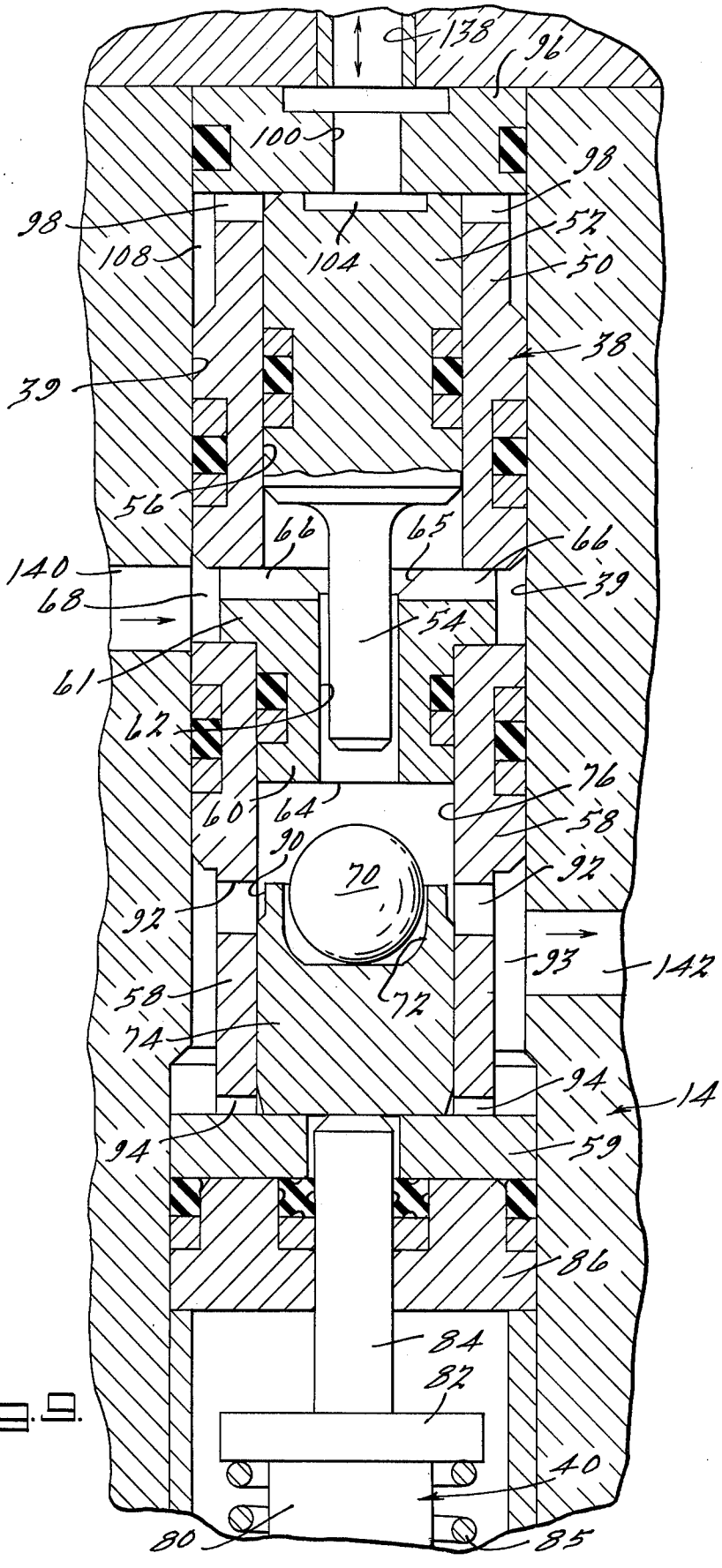

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Fig. 9.

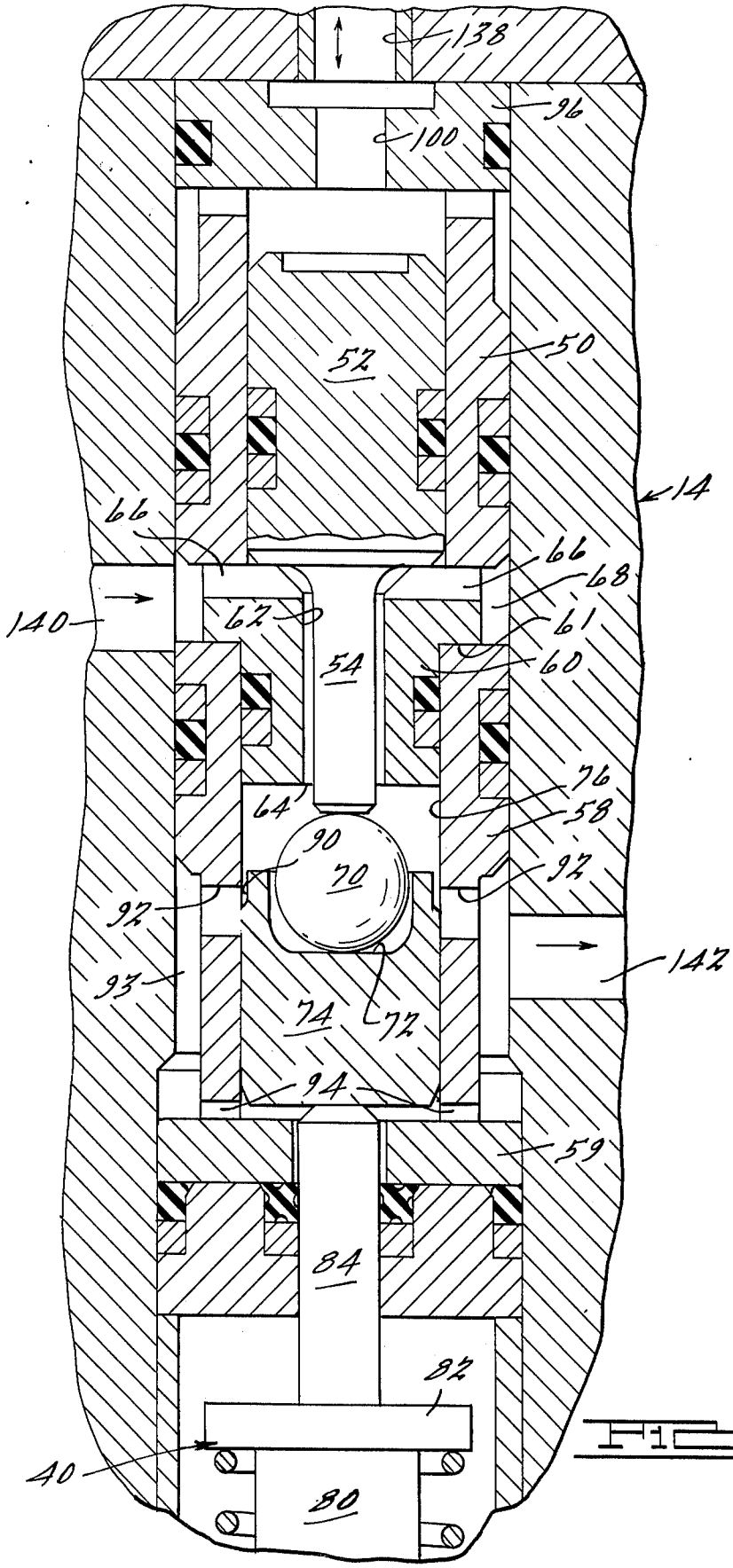
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FIG. 10.

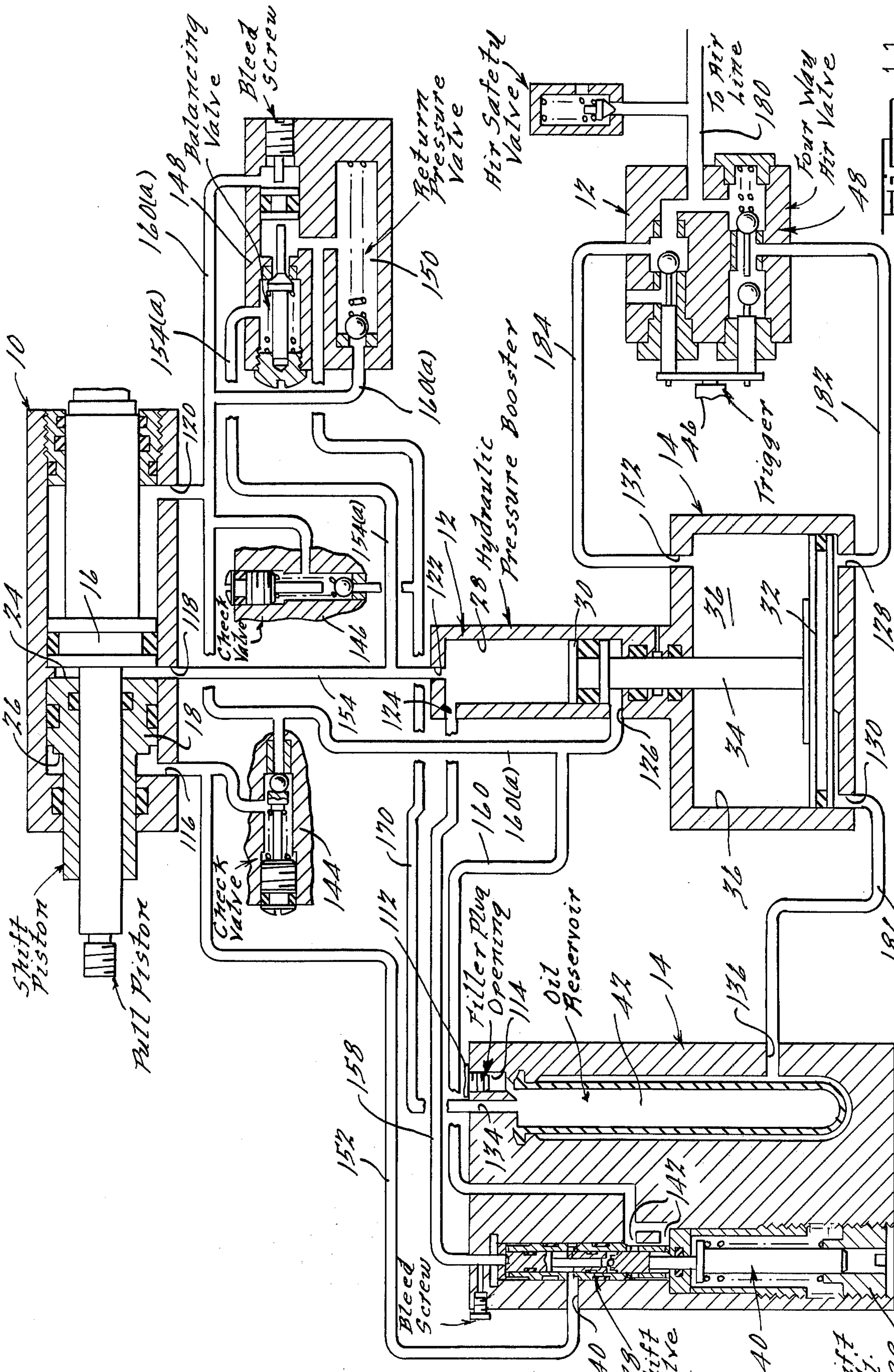

Balancing Valve
Bleed Screw
Return Pressure Valve
Air Safety Valve
To Air Line
Four Way Air Valve
Trigger
Hydraulic Pressure Booster
Check Valve
Check Valve
Filler Plug Opening
Oil Reservoir
Shift Piston
Pull Piston
Bleed Screw
Shift Valve
Shift Adj.

FIG. 11

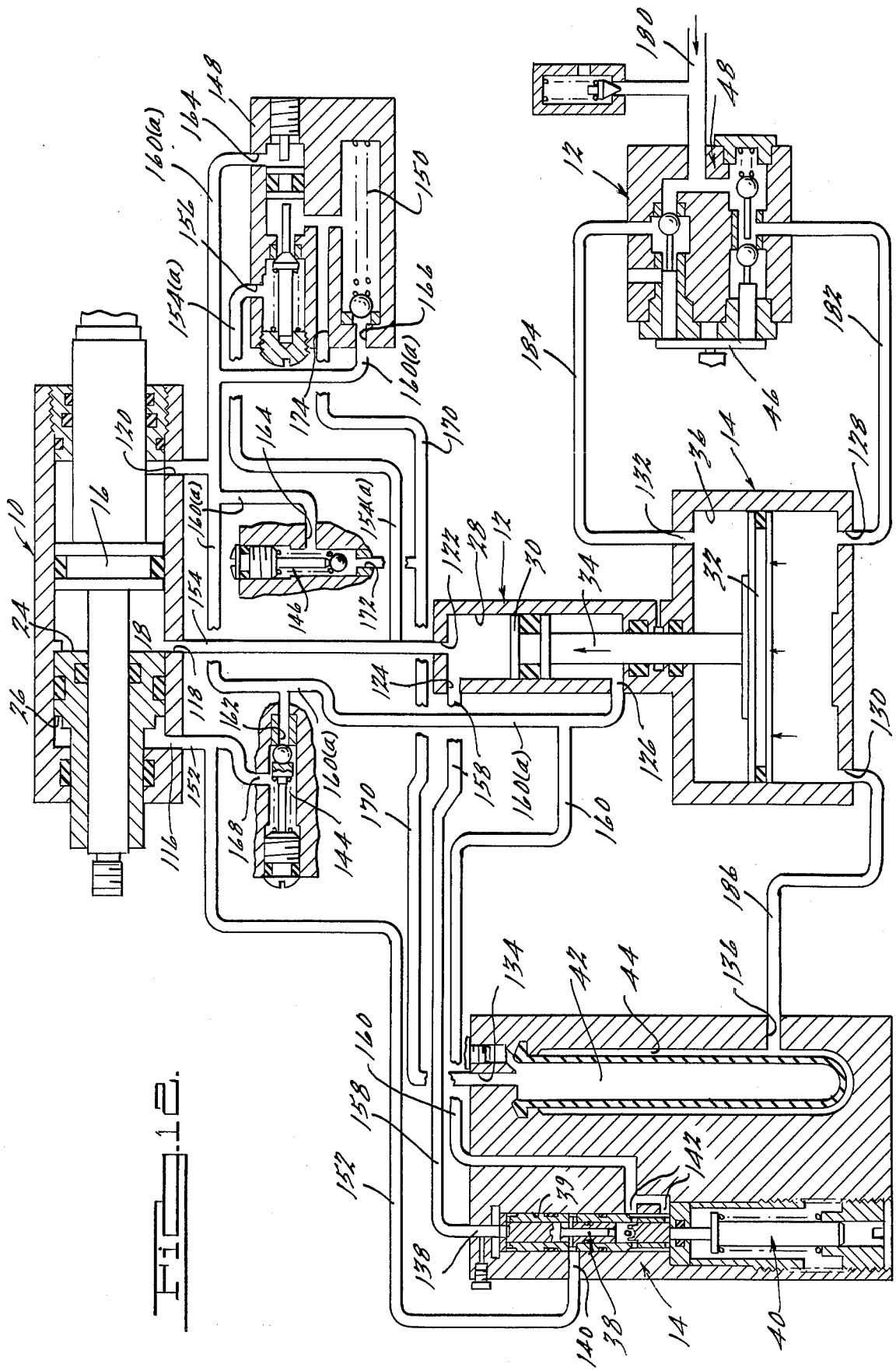
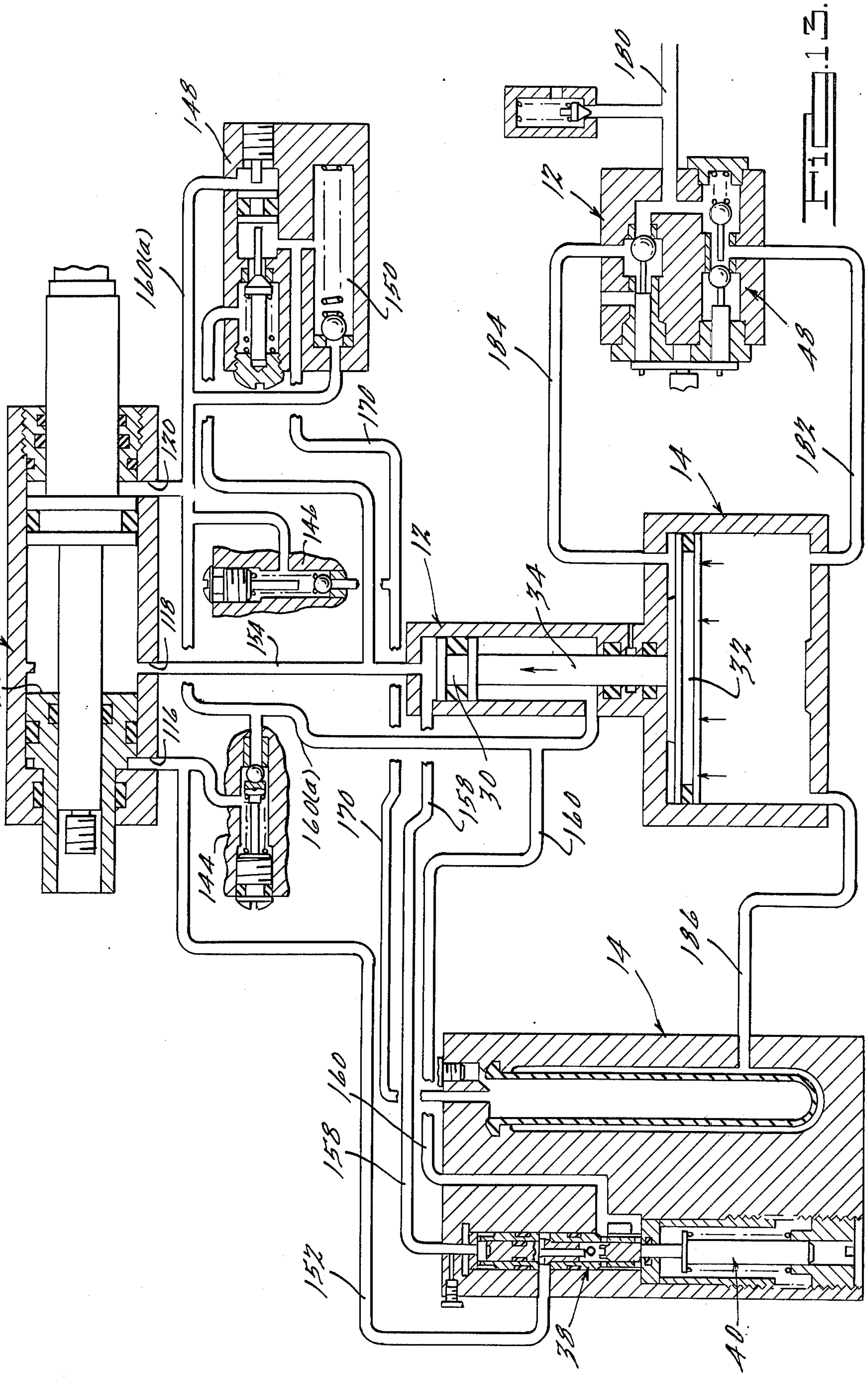


Fig. 12.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DOUBLE ACTION FASTENER INSTALLATION TOOL FOR BLIND RIVETS AND THE LIKE

BACKGROUND OF THE INVENTION

This invention relates broadly to double action fastener installation tools.

The pertinent prior art is indicated by VanHecke U.S. Pat. No. 2,820,566 and the technical brochure of the Huck Manufacturing Company, entitled, "Instruction Manual, Model 200 Installation Tool," copyrighted under notice 1965, 1975. Both of these disclosures are incorporated herein by reference.

The present application is also related to application Ser. No. 564,078 filed Apr. 1, 1975, and assigned to Huck Manufacturing Company, such application having been abandoned.

The primary object of the present invention is to assure the proper functioning of a double action installation tool by the incorporation of an improved shift valve mechanism so constructed and associated with the oil pressure circuit as to prevent premature actuation of the shift piston.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a longitudinal sectional view of a double acting installation tool embodying the present invention such as the type shown in the VanHecke patent and the Huck Manual referred to;

FIG. **2** is a side elevation view, with parts in section, of the tool shown in FIG. **1** and taken substantially in the direction of the Arrow **2**;

FIG. **3** is a cross sectional view taken substantially along the Line **3—3** of FIG. **1**;

FIG. **4** is an enlarged cross sectional view of the improved shift valve mechanism with the parts in neutral or rest position as related to FIG. **11**;

FIG. **5** is a cross sectional view taken substantially along the Line **5—5** of FIG. **4**;

FIG. **6** is a cross sectional view taken substantially along the line **6—6** of FIG. **4**;

FIG. **7** is a cross sectional view taken substantially along the Line **7—7** of FIG. **4**;

FIG. **8** is a cross sectional view taken substantially along the Line **8—8** of FIG. **4** and showing the shift valve elements in the position related to schematic view FIG. **11**;

FIG. **9** is a view similar to FIG. **4** showing the shift valve elements in an intermediate position with the trigger depressed and in a position related to schematic view FIG. **12**;

FIG. **10** is a view similar to FIG. **4** and showing the valve elements in a final power position with the trigger depressed and in a position related to schematic view FIG. **13**;

FIG. **11** is a schematic fluid circuit diagram for the tool of the present invention as illustrated in the figures previously described, with the trigger not depressed and with the pull and shift pistons shown in rest position and the shift valve positioned as in FIG. **4**;

FIG. **12** is also a schematic view similar to FIG. **11**, with the trigger depressed, with the pull and shift pistons as well as the air cylinder and hydraulic cylinder at intermediate positions of their strokes and the shift valve positioned as in FIG. **9**;

FIG. **13** is also a schematic view similar to FIG. **12**, with the trigger depressed, at the end of the stroke of the pull and shift pistons as well as the air and hydraulic pistons, and with the shift valve positioned as in FIG. **10**.

SUMMARY OF THE INVENTION

The installation tool of the present invention is designed to install a wide range of fasteners requiring a double action installation tool, particularly blind rivets of the lock spindle type. Power, speed and accuracy are obtained through a pneumatic hydraulic intensifier system powered by 90 to 100 PSI air.

The tool consists of three major subassemblies. One is the head assembly which includes a pull piston and a shift piston. The second is a handle and piston assembly which includes the triggering system and the pneumatic and hydraulic pistons. The third is a cylinder assembly which includes an adjustable shift valve mechanism to control precisely the installation of fasteners requiring a double action tool and so constructed and associated with the hydraulic and air power systems that premature shift will not occur. Premature shift causes a malfunction in the installed fastener.

DESCRIPTION OF THE PREFERREED EMBODIMENT AND BEST MODE OF OPERATION

Referring to the drawings, and referring particularly to FIGS. **1**, **2** and **3**, a double action pneu-draulic fastener tool is shown. The tool consists of three major subassemblies: the head assembly which includes the pull piston and the shift piston, the handle and piston assembly which includes the triggering system and the pneumatic and hydraulic pistons and the cylinder assembly which includes an adjustable shift valve mechanism. Such a tool is generally that disclosed in the aforesaid VanHecke patent and in the Huck Instruction Manual previously referred to. It is in the construction and arrangement of the shift valve mechanism and its functional relationship with the hydraulic pressure lines so that the shift valve mechanism responds to pressure differentials to directly monitor pressure in the trapped oil circuit and prevent premature shifting of the shift piston to which the present invention is directed.

The head assembly is generally indicated at **10**, the handle assembly is generally indicated at **12** and the cylinder assembly is generally indicated at **14**.

The head assembly **10** has a pull piston **16** and a shift piston **18** mounted therein for reciprocal movement between a front nose gland **20** and a rear nose gland **22**.

The rear face **24** of the shift cylinder **18** is approximately and preferably **35** percent larger than the area of the forward face **26** on the opposite side. Thus, the trapped oil is always intensified by **35** percent over the pull pressure. Suitable nose assemblies are mounted on the forward end of the pull piston in the usual way to accomodate particular fastener diameters and grips.

The handle and piston assembly **12** has a bore **28** therethrough which slideably receives the hydraulic plunger **30**. The hydraulic plunger **30** is connected to the air piston **32** by rod **34**. The air piston **32** is mounted within a cylindrical bore **36** in the cylinder assembly **14** and the rod slideably projects through a sealed opening through which the rod reciprocates in the operation of the tool.

A shift valve generally indicated at **38** is mounted within a bore **39** of the cylinder assembly housing and such shift valve is adjusted by a shift valve adjustment mechanism generally indicated at **40**.

An oil reservoir **42** in the form of a flexible, diaphragm tubular member is mounted within a bore **44** in the cylinder housing in spaced relation to the adjacent wall of the bore **44**.

A trigger **46** is mounted on the handle and actuates a four-way valve generally indicated at **48** to operate the installation tool in a manner that will become clear from later descriptions, and generally in the same sequences as in the VanHecke patent and Huck Manual.

With the exception of the detailed construction and arrangement of the shift valve **38** the tool so far described is substantially the same in structure and function as that disclosed in the aforesaid VanHecke patent and Huck Instruction Manual.

The detailed construction of the shift valve is best shown in FIGS. **4** through **8** and illustrated in different positions in FIGS. **4**, **9** and **10**.

The shift valve **38** comprises an upper sleeve **50**, a plunge **52** and a depending integral and centrally located stem **54** mounted within a bore **56** in the upper sleeve **50** for reciprocal movement therein.

A lower sleeve **58** is also mounted within the bore **39** and rests upon valve seat **60** which is mounted within the housing **14**.

A valve seat member **60** has an annular flange **61** at the upper end which rests on the upper surface of the lower sleeve **58**. The valve seat has a central opening **62** therethrough the lower end of which defines a valve seat **64**. The upper end of the seat **60** terminates in a tapered opening **65** which has radial passages **66** formed therein communicating adjacent their inner ends with openings **65** and **62** and communicating at their outer ends with an annular space **68** formed around the periphery of the seat **60** and between the facing surfaces of the upper sleeve **50** and the lower sleeve **58**. The depending stem **54** extends within the opening **62** for a movement therein in a manner and for a function to be hereinafter described.

A ball **70** loosely seats within an upwardly opening recess **72** in a ball guide **74**.

The ball **70** is adapted to seat against the valve seat **64** (FIG. **8**) to prevent the upward flow of hydraulic fluid therethrough, when in one position and to be moved away from the seat **64** by hydraulic fluid in another position (FIG. **9**) to permit initial downward fluid flow and momentarily thereafter be held away from the seat **64** by the depending stem **54** when in another position (FIG. **10**).

The ball guide **74** is vertically movable within the bore **76** of the lower sleeve and is vertically adjustable so as to precisely adjust the resistance of the movement of the ball **70** with respect to the valve seat **64**. This is accomplished by the shift valve adjustment mechanism **40**. Such mechanism **40** includes a depending central cylindrical member **80** having an annular flange **82** at the upper end and an upwardly extending integral pin **84** which extends through a sealed opening in the cap **86** and through a central opening in the spacer **59** to engage the undersurface of the ball guide **74**. A valve spring **85** embraces the cylindrical member **80** and bears against the underside of the flange **82** urging the pin **84** upwardly against the abutting undersurface of the ball guide. The lower end of the spring is engaged by an adjustable screw **88** (FIGS. **1** and **11**). By adjusting the screw **88** the spring pressure of the stem **84** against the undersurface of the ball guide **74** is adjusted so as to precisely adjust the resistance of movement of the ball **70** with respect to the valve seat and particularly to adjust the resistance to move the ball away from the seat.

The upper end of the ball guide **74** has an annular reduced portion **90** at the upper end so as to provide passage for oil flow to adjacent ports as will be more apparent from the following description.

The lower sleeve **58** is provided with a plurality of radial ports **92** intermediate the ends thereof and also with corresponding radial slots **94** adjacent the lower end thereof.

A cap **96** is disposed within the bore **39** adjacent the upper end and seats on the top of the upper sleeve **50**. The adjacent top portion of the sleeve **50** is formed with a pair of diametrically opposed radial passages **98**. The cap **96** is formed with a central cylindrical port or passage **100** therethrough which communicates at its lower end with the bore **39**. The top of plunger **52** is formed with a transverse slot **104** which forms a pair of transverse ridges **106**. Such ridges **106** serve to prevent flat area, metal to metal contact between the top of the plunger **52** and the faying surface of the cap **96** around the port **100** to insure easy oil flow.

The upper end of the sleeve **50** has a reduced O.D. to provide an annular chamber **108** with which the passages **98** communicate. Communication with the chamber may be had by removing screw **110** (FIG. **1**) and applying a pressure gauge to test the fluid pressure in the line.

Suitable seals, usually "O"-rings, are disposed on the various elements described and shown so as to seal the flow of fluid between adjacent surfaces as would be evident to those skilled in the art.

An air collector tube **112** is attached at the filler plug opening **114** (FIGS. **2** and **11**). This permits any entrapped air circulating back to the reservoir to drift away from the reservoir supply opening. This precludes air entering the reservoir from being reintroduced to the system on the next stroke. Thus, this air collector allows the tool to self-bleed small quantities of air while installing fasteners.

The required ports and conduits for the oil and air passages are formed in the housings for the head assembly, the handle and piston assembly and the cylinder assembly as in the VanHecke patent and Huck Manual previously referred to. Also the bores for locating the check valves, the balancing valve, the return pressure valve, the four-way operating valve and the air safety valve are likewise formed and arranged in the same manner as in these prior references.

The construction and function of these elements may best be understood by reference to the schematic drawings FIGS. **11**, **12** and **13** as related to their corresponding shift valve drawings FIGS. **4**, **9** and **10**, respectively.

The head assembly is provided with a port **116** adjacent to the forward end of the head and forwardly of the shift piston, a port **118** intermediate the ends of the head and between the shift piston and the pull piston, and a port **120** adjacent the end of the head and behind the pull piston **16**.

Communication with the bore **28** of the hydraulic piston is provided through ports **122** and **124** adjacent the top of the bore and forwardly of the leading end of the piston **30**. A port **126** is provided adjacent the lower end of the bore **28** and on the back or underside of the piston **30**.

Ports **128** and **130** are provided in the housing of the cylinder assembly and at the lower end of the cylinder bore **36** and under the piston **32**. Another port **132** is

provided in the cylinder assembly adjacent the top of the bore **36**.

That part of the cylinder assembly which houses the shift valve and the oil reservoir is provided with ports **134** and **136**, the port **134** communicating with the open top of the oil reservoir **42** and the port **136** communicating with the space **44** surrounding the flexible reservoir **42**.

A port **138** is provided which communicates with the top of the bore **39**. A port **140** also communicates with the bore **39** adjacent the passages **66** in the shift valve (FIG. **4**). Another port **142** also communicates with the bore **39** adjacent the port **92** and the surrounding space **93**.

Check valves **144** and **146** and balancing valve **148** and return pressure valve **150** are provided in the head assembly.

These portings and the check valves, balancing valve, return pressure valve and the four-way valve are substantially the same as in the VanHecke patent and Huck Manual referred to. Their operations and functions are also substantially the same.

The conduits connecting the ports are also substantially the same and are identified as follows:

Conduit **152** connects port **116** with port **140**. Conduit **154** connects port **118** with port **122** and branch conduit **154***a* connects conduit **154** with port **156** of the balancing valve.

Conduit **158** connects port **138** of the shift valve with port **124** of the hydraulic piston.

Conduit **160** connects port **126** with the port **142** of the shift valve and open branch conduit **160***a* also connects ports **126** and **142** with a port **162** of the check valve **144** and with a port **164** of check valve **146**. Conduit **160***a* also communicates with port **164** of the balancing valve **148** and port **166** of the return pressure valve **150**.

Conduit **152** communicates with check valve **144** through port **168**.

Port **134** which communicates with the oil reservoir **42** communicates through conduit **170** with port **172** of the check valve **146** and with port **174** of the balancing valve **148**.

The description of the conduits thus far relates to the hydraulic system which is a closed system and with the conduits and piston cylinders completely full of hydraulic fluid at all times.

Air pressure is provided from a suitable source to the four-way valve **12** through conduit **180**. The four-way valve **12** acts as in the prior references when depressed to provide air under pressure by conduit **182** communicating with port **128**. When the trigger is depressed, this acts on the underside of the air piston **32** to force it upwardly and to force the piston **30** upwardly.

A conduit **184** connects the four-way valve **12** with the port **132** and the chamber **36** above the piston **32**.

Port **130** in the bottom of the air cylinder connects with the port **36** by conduit **186** and air under pressure is thus provided around the flexible diaphragm oil container **42** to assure that the oil system is completely filled.

Referring to FIGS. **4** and **11**, the trigger is open and the system is full of hydraulic fluid and all parts are in neutral or rest position. That is, the pull piston **16** is to the left of its housing and the shift piston **18** is to the right of its housing, viewing FIG. **11**. The ball **70** is against the valve seat **64**, out of contact with the stem **54** of the plunger **52**. The ball guide has been properly adjusted by adjusting the shift adjuster **40** so that the ball will be held against the seat **64** against fluid pressure in the chamber surrounding the ball tending to move it and the valve guide away from the valve seat **64** and against the action of the spring **85** from the pressure exerted against the top of the ball from the fluid pressure in conduit **152** through port **140**, passages **66** and in space around the stem **54** within the opening **62** of the valve seat.

At that time there is no air pressure acting upon the air plunger **32** and consequently no pressure exerted on the oil within the chamber **28** by the hydraulic piston **30**.

When the trigger **46** is depressed, air under pressure passes through the four-way valve into the underside of the chamber **36** through conduit **182** and port **128**. That same air pressure acts through port **130** and conduit **186** and port **136** to place the diaphragm **42** under pressure and assure that the system is full of oil.

As the air piston **32** moves upwardly, the hydraulic piston **30** correspondingly moves up forcing hydraulic fluid under pressure through conduit **154** and into the pull piston chamber forwardly of the pull piston as shown in FIG. **12** to cause the pull piston to move to the right, viewing FIG. **11**. As the piston **16** pulls the fastener, it will meet resistance at a predetermined point in the setting of the fastener so that the pressure within the pull piston chamber forwardly of piston builds up to act against the rear face **24** of the shift piston. As this pressure builds up, the build up force is in direction to move the shift piston toward the left (viewing FIG. **12**) and because of the differential in the area of the faces **24** and **26** the pressure forwardly of the shift piston will be increased by approximately **35** percent greater than the pressure in the chamber behind the shift piston. This higher pressure acts through port **116**, conduit **152**, port **140** and passages **66**. That increased pressure within acts against the top of the ball valve **70** in the area around the stem **54**. Referring to FIG. **9** and FIG. **12**, the pressure has thus built up to cause the shift piston to move forward and to cause the ball **70** to move away from its seat. However, at this stage the plunger **52** has not moved as yet, but will move downward momentarily. During this very short time, the pressure within the lower sleeve, under the seat **60** will cause the fluid to move in the space **90**, out the passages **92**, through the port **142** and into the conduit **160**.

The pressure will then drop under the plunger **52** and as the hydraulic plunger **30** continues in its upward movement hydraulic fluid is forced through port **124**, conduit **158** and port **100**. This pressure acting against the top of the plunger **52** will cause the stem **54** to engage the ball **70** holding it away from the valve seat **64**, as shown in FIGS. **10** and **13**.

The valve parts will be held in this position until the driving cycle has been completed, i.e. until the fastener is completely set.

At that time the trigger **46** is released and returned to its original "at rest" position shown in FIG. **11**. The shift valve elements at the same time are returned to the position shown in FIG. **4**. The check valve **144** and the balancing valve only open on the return stroke of the pull piston. This return movement and the movement of the oil pressure are the same as in the prior VanHecke patent and Huck Manual. This is also true of the four-way valve **48** which is spring returned to its original position as shown in FIG. **11** when the trigger is released.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

I claim:

1. A fastener installation tool of the fluid actuated pull gun type comprising in combination,

a head assembly including a pull piston and a shift piston,

a handle and piston assembly including a hydraulic piston and an air piston directly connected thereto and trigger means for actuating a fluid circuit,

a cylinder assembly including an air cylinder for receiving said air piston and shift valve means,

said fluid circuit being constructed and arranged for the supply of fluid under pressure upon actuation of said trigger to first said pull piston to cause pulling of a fastener and upon a predetermined pressure build up cause said shift piston to move forward to set the fastener,

said shift valve being constructed and arranged in said circuit to be operable upon said predetermined pressure build up to cause said shift piston movement,

said fluid circuit including a trapped fluid circuit between the forward face of said shift piston and said shift valve,

and said shift valve including a ball valve held against a valve seat until said predetermined pressure is reached and arranged in said circuit to prevent shifting of said shift piston until unseated by said predetermined pressure,

said trapped fluid circuit pressure responding to said pressure build up to unseat said ball valve and thereby relieve the trapped fluid pressure forward of said shift piston to permit said shift piston to move forward to set the fastener.

2. A fastener installation tool according to Claim 1 in which said shift valve includes a plunger having a depending stem, movement of said plunger being controlled to cause said stem to contact said ball and hold said ball away from its valve seat momentarily after unseating of said ball valve.

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